

A NEW SPECIES OF FROG OF THE GENUS *CRINIA* TSCHUDI FROM
SOUTH-EASTERN AUSTRALIA.

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(Communicated by Mr. S. J. Copland.)

(One Text-figure.)

[Read 30th July, 1958.]

Synopsis.

Differences in male call, as measured by objective sound analysis, initially indicated the presence of a new species of *Crinia* in south-eastern Australia. This characteristic together with other biological (breeding behaviour and *in vitro* crossing) and morphological data has been used to confirm the status of the new form with respect to two closely related sympatric species, *C. signifera* Girard and *C. parinsignifera* Main. The new species is grouped with the *C. insignifera* superspecies. A description is given at the conclusion of the paper.

INTRODUCTION.

Differences in male call are generally considered to act as important reproductive isolating mechanisms between related species of Anura (Blair, 1955, 1956). Thus the revealing of distinct and discontinuous variability of call structure within one presumed biological species leads to the suspicion that more than one species may be present.

While travelling through the Riverina district of Victoria and New South Wales during August, 1957, with the aim to obtaining additional amphibian material and tape recordings of male calls of *Crinia parinsignifera* Main and *C. signifera* Girard, samples of a previously unrecorded Crinine call were obtained. The new call was quite distinct from those of the other two species to which collected specimens appeared to show close morphological affinity. All three call types were heard and recorded calling together in several localities without any evidence of intergradation in call structure. Subsequent examination of collected material showed that males of the new call type could be readily distinguished on morphological grounds, but that greater difficulty was experienced with females. The new form showed no close relationships to any species of *Crinia* from south-western Australia.

RELATIONSHIPS.

On the basis of its morphology, biology and call structure the new call type should be included within the *C. insignifera* superspecies of Main (1957).

This latter author has discussed at some length the highly variable texture and patterns on the dorsal surface of these species and has separated distinct variants or polymorphs into four categories, namely:

1. *Striped*: animals in which two continuous longitudinal ridges and several variously coloured yellow, brown or red stripes traverse the back.
2. *Lyrate*: two raised lyre-shaped ridges are found on the shoulders. No longitudinal ridges or stripes are present.
3. *Warty*: the back lacks either of the above conditions, but is covered in numerous fine warts or spicules.
4. *Smooth*: no raised dermal areas are present and the pigmentation is uniform.

These polymorphs may be present in varying proportions in all the previously described members of the *C. signifera-insignifera* complex. There is also marked

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variation in back colour and distribution of pigments. In the new species, however, only one back pattern type has been found, namely the lyrate type, the light mustard-brown back colour and occasional ochre-capped warts being consistent with the lyre markings.

Main (1957) also considered the degree of pigmentation of the male throat and the colour and pigmentation of both male and female belly to be of some assistance in species diagnosis in the complex. These characteristics are here considered with regard to the two sympatric species *C. parinsignifera* and *C. signifera* and the new species. The throat of a breeding male of the new species has a pale grey-green pigmented band around the mandible border with a fainter grey pigmentation in life extending back to the forearms. In spirit the colour assumes a uniform light grey appearance, while the belly is granular, dirty-white and sparsely flecked in black. The female throat is white, immaculate, while the skin of the granular belly may carry small pigmented black flecks. In males of *C. signifera* the very dark pigmentation of the throat extends posteriorly to or slightly beyond the forearms, where two white pectoral spots may be present. The male belly is often darkly pigmented in parts either in blotches or spots. The female has a white throat, but the belly is usually heavily pigmented in an extremely variable pattern in which extensive blotches may run together to give a dark appearance.

C. parinsignifera males show slightly reduced pigmentation of the throat compared with that of *C. signifera*, and a white belly, while the females have a white belly and throat.

DISTRIBUTION AND HABITAT.

The new species has been collected and heard calling in the Murray River Valley from Mulwala through to Echuca. It was not found at Mildura, Victoria, nor north of Deniliquin and Finley, New South Wales. However, males were heard calling on the plains country close to the foothills of the Great Dividing Range between Wangaratta and Whitfield, Victoria. In the latter localities the habitat consisted of shallow temporary ponds in clay soil, but in the other localities the species was generally restricted to temporary ponds in the river valleys and up to five miles on either side of the larger rivers.

Throughout the entire known range the new species is broadly sympatric with either *C. parinsignifera* or *C. signifera*, often with all three species occurring together.

C. signifera is found in permanently wet situations throughout the Great Dividing Range and south and east thereof with an extension into the higher rainfall areas of the western foothills and along the greater river valleys farther west.

C. parinsignifera occupies the drier areas inland to the west of the Great Dividing Range and generally inhabits temporary summer-dry ponds of this region.

BREEDING BIOLOGY.

Male Call Characteristics.

Samples of male calls were obtained for all three species under natural conditions using portable tape recording apparatus. Calls of the new species and of *C. parinsignifera* were analysed by cathode ray oscilloscope and the following acoustical characteristics determined: call duration, number of pulses, and pulse repetition frequency and approximate carrier frequency. These characteristics for *C. signifera* were determined by the Ferrogram method of Frings and Frings (1956) (excepting carrier frequency which was determined by oscilloscope). In all three species call repetition rate was calculated by measuring with a stop-watch the time taken for an individual to make ten successive calls.

The results of the analyses are presented in Table 1. The data used were corrected to an effective recording temperature of 10°C. in order to minimize any variation in call structure due to temperature effects, the correction factor being determined by regressing each call characteristic against effective temperature using the method of least squares. The oscillograms are presented in Text-figure 1, and verbal call descriptions are given in diagnosis of the species.

Breeding Season.

The area was visited during August, 1957, when all three species were heard calling strongly. Three mating pairs of the new form were seen during this time. Main (1957) collected gravid females of *C. signifera* and *C. parinsignifera* during the same month in 1955, so that it may be assumed that no marked seasonal isolation is present.

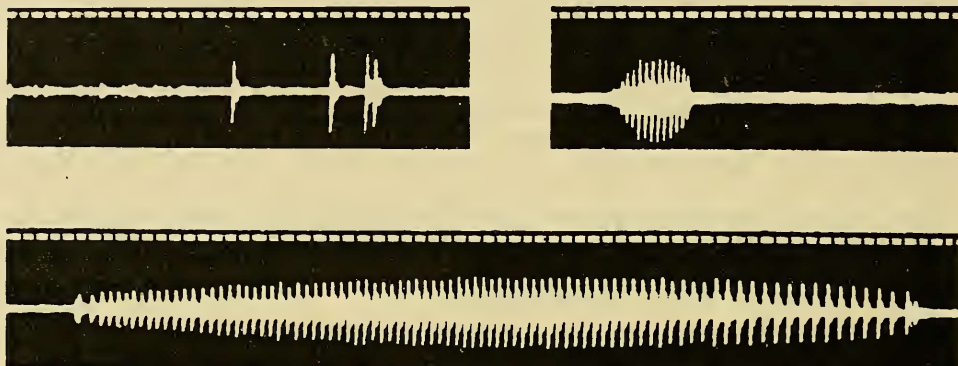


Fig. 1.—Oscillograms of calls of *C. signifera* (upper left), *C. sloanei* (upper right), and *C. parinsignifera* (lower). Each spot in the line across the top of the traces is equal to 0.01 second.

Calling and Breeding Temperatures.

All three species have been heard in chorus over the temperature ranges: air, 5.0–10.5°C.; water, 7.0–10.75°C.

Mating pairs of the new species were collected at air temperatures of 9.0°C., and water 9.5°C., while Main (per. com.) collected females of *C. signifera* and *C. parinsignifera* at air 7.5°C., and water 9.5°C. It seems reasonable to assume that here no effective temperature isolation is operating.

TABLE 1.

Data from Call Analyses of Recordings from Victoria and New South Wales, Corrected to a Common Temperature of 10° C. Mean value ± standard error of the mean and ranges are given for each species.

Call Characteristic.	Species.		
	<i>sloanei</i> .	<i>parinsignifera</i> .	<i>signifera</i> .
Sample size (number of individuals) ..	17	35	14
Duration (secs.)	0.06 ± 0.001 (0.06–0.08)	0.48 ± 0.01 (0.32–0.59)	0.15 ± 0.006 (0.12–0.19)
Number of pulses	13.0 ± 0.4 (11.0–16.0)	78.0 ± 1.8 (56.0–100.0)	5.0 ± 0.3 (4.0–9.0)
Pulse repetition frequency (C.P.S.) ..	214.0 ± 5.3 (166.0–250.0)	167.0 ± 2.7 (141.0–219.0)	31.0 ± 1.6 (25.0–49.0)
Call repetition rate (secs.)	9.7 ± 0.28 (7.7–11.4)	61.5 ± 2.7 (39.0–115.4)	6.0 ± 0.2 *(4.7–8.2)
Approximate carrier frequency (C.P.S.) ..	2600	2800	2500

* N = 24.

Sample compositions and effective temperatures.

- C. sloanei* Mulwala, N.S.W., 9, 10.75°C.; Tocumwal, N.S.W., 8, 10°C.
C. parinsignifera Mulwala 7, 10.75°C., 7, 6.75°C.; Echuca, Vic., 13, 9.0°C.; Kingston on Murray, S.A., 5, 16.5°C.; Horsham, Vic., 3, 7.7°C.
C. signifera Tocumwal, N.S.W., 7, 10.0°C.; Wangaratta, Vic., 7, 10.5°C.

Calling Position.

Males of the new species usually call while floating in open water of temporary ponds. *C. parinsignifera* males call while out of water, 1-4 inches above the surface, supported by tussocks of dried grass, either at the centre or periphery of the temporary ponds. *C. signifera* males call while partly immersed in the water, sitting on submerged vegetation at the borders of ponds, and generally under cover of overhanging grasses.

Some variation in calling position does occur, particularly when the males are moving into the breeding sites. From the overall distinctness, however, it is suggested that such behaviour could assist in maintaining efficient reproductive isolation.

IN VITRO CROSSES.

Some crosses were made under field conditions, following as closely as possible the methods of Rugh (1948), and, while giving poor larval survival in both the experimentals and controls, do indicate that the cross ♀ new species × ♂ *C. signifera* can yield apparently normal offspring to metamorphosis (Table 2). In the cross ♀ new species × ♂ *C. parinsignifera* no embryos developed beyond gastrula but it cannot surely be said whether the failure was due to genetical breakdown or to poor experimental conditions.

TABLE 2.
Results of In-vitro Crosses between the Three Species of Crinia.

Female.	Male.	Initial Egg Number.	Hatched.	Metamorphosed.
<i>sloanei</i> × <i>parinsignifera</i>	22	1	0
<i>sloanei</i> × <i>signifera</i>	26	8	2
<i>sloanei</i> × <i>sloanei</i> (control)	21	7	4 and 1 delayed

DISCUSSION AND DESCRIPTION.

From the above analysis it appears that efficient pre-mating reproductive isolation is maintained principally by differences in male call and is probably assisted by preference for distinct calling positions. There are not sufficient experimental data available as yet to predict whether significant gene flow could occur if the pre-mating mechanisms broke down and there is no evidence of interbreeding in the sympatric field populations.

The distinctness of male call, sympatric occurrence with *C. parinsignifera* and *C. signifera* without evidence of integradation and the consistent morphological distinctness when considered together indicate that this new population warrants species status for which the following description is given.

CRINIA SLOANEI, sp. nov.*

Types.—Holotype: 466/57. A sexually mature male in the Zoology Department Collection at the University of Western Australia, taken in a temporary pond, on the south bank of the Murray River by the Main Traffic and Railway Bridge adjacent to Tocumwal on Murray, New South Wales. Allotype: 473/57. Zoology Dept. Univ. W.A. Coll. Paratypes: 465/57, 467/57, 468/57, 470/57. Zool. Dept. Univ. W.A. Coll.

All specimens were collected by M. J. and P. G. Littlejohn on 6th August, 1957.

To be lodged with the Australian Museum, Sydney, New South Wales, together with a tape recording of typical calls and photographs of oscilloscope traces.

Description.

Vomerine teeth absent. Snout short and rounded, 1.3 times as long as the eye; canthus rostralis rounded; loreal region oblique; tympanum indistinct; fingers long, free, with some subarticular tubercules; toes free, long, often with dermal fringes; two metatarsal tubercules; tibio-tarsal articulation reaching eye or tympanic region.

* The name is designated in appreciation of the assistance of Mr. Ian F. Sloane, of "Savernake Station", Savernake, New South Wales, without whose co-operation collection in this area would not have been possible.

Dorsum smooth except for two consistent (in life prominent) lyre-shaped ochre-coloured ridges over shoulders; posterior regions sometimes bearing a few small ochre-capped warts; dorsum a mustard-yellow colour in life, but pale grey-brown in spirits.

Ventral surface prominently granular; throat of females white, while males have a (greyish-green in life) grey border to mandible and a pale grey throat; belly of both males and females white and sparsely flecked with small black spots.

Body Lengths.

Samples of breeding adults from Tocumwal showed the following mean snout-vent measurements: Males: 15.6 mm. (S.D. 0.4 mm.); N = 16. Females: 17.6 mm.; N = 2.

Range and Habitat.

Found associated with temporary ponds along Murray River from Wangaratta to Echuca and in the south-eastern part of the plains adjacent to the western face of the Great Dividing Range near Wangaratta and Whitfield, Victoria, and north of the Murray River to Deniliquin and Finley, New South Wales.

Diagnosis.

a. Morphology: The consistent mustard-yellow-coloured back and the lyre-shaped markings are characteristic of the new species, all the others of the complex being polymorphic in back pattern and variable in colour. The pale pigmented area of male throat may be of some assistance when comparing with the more extensive pigmentation of throats of males of *C. parinsignifera* and *C. signifera*.

b. Call: The call of the new species may be described as a short metallic "chick" regularly and rapidly repeated; that of *C. parinsignifera* is a long low "squelch" or "buzz" repeated very slowly. *C. signifera* males make a short 4-7-pulsed call which is rapidly repeated, described by Harrison (1922) as "Crick-ick-ick-ick-ick". The physical characteristics are given in Table 1.

c. Inviability: There are indications that crosses *C. parinsignifera* ♂ × *new species* ♀ are inviable, while crosses *C. signifera* ♂ × *new species* ♀ show low viability but that some survivors reach metamorphosis (Table 2).

Acknowledgements.

The work was carried out while the author was in receipt of a research grant from the University of Western Australia.

The author acknowledges the assistance of Patricia G. Littlejohn in field collecting. He is also indebted to Dr. W. F. Blair for reading the manuscript.

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